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(54) SYSTEMS FOR REMOTE MANAGEMENT OF A NETWORK OF WASTE CONTAINERS

(76) Inventors: Martin J. Durbin, Oak Forest, IL (US); Jay S. Simon, Northbrook, IL (US)

Correspondence Address:
ROCKEY, MILNAMOW & KATZ, LTD.
TWO PRUDENTIAL PLAZA, STE. 4700
180 NORTH STETSON AVENUE
CHICAGO, IL 60601 (US)

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Publication Classification

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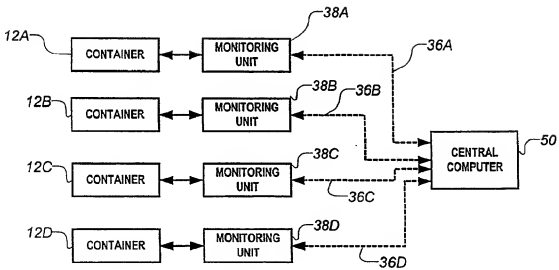
(52) U.S. Cl. 702/188

(57) ABSTRACT

A system for remotely managing a network of waste containers (12), each of which is associated with a monitoring unit (38), utilizes a central computer (50) having a communication link to each monitoring unit (38). The central computer (50) provides a dynamically updated display, via a display module (60) having a full container window (or zone) which shows full containers (12), an alarm window (or zone) which shows non-full containers (12) having an alarm condition, and a container status window (or zone) which shows non-full containers not having an alarm condition. The system additionally includes one or more remote monitors (404) capable of providing user access to the container status information maintained by the central computer (50, 402).



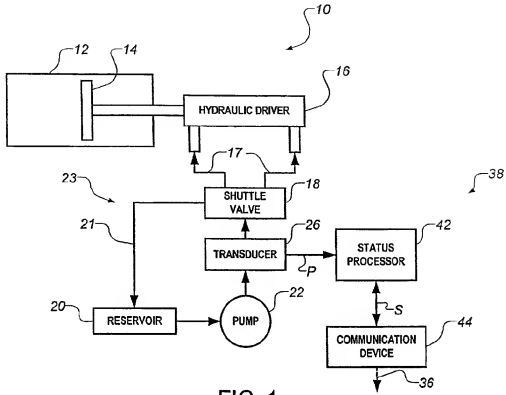

10
12
14
16
HYDRAULIC DRIVER
17
23
18
SHUTTLE VALVE
38
21
26
TRANSDUCER
STATUS PROCESSOR
42
P
20
RESERVOIR
PUMP
22
S
44
COMMUNICATION DEVICE
36

FIG. 1

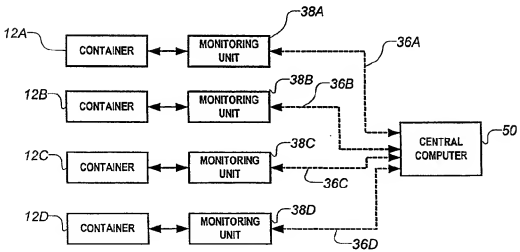

38A
12A
CONTAINER
MONITORING UNIT
36A
38B
36B
12B
CONTAINER
MONITORING UNIT
CENTRAL COMPUTER
50
38C
12C
CONTAINER
MONITORING UNIT
36C
38D
12D
CONTAINER
MONITORING UNIT
36D

FIG. 2

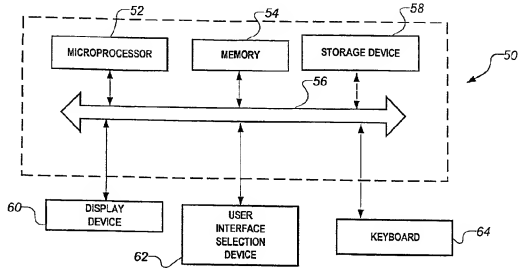

52
54
58
MICROPROCESSOR
MEMORY
STORAGE DEVICE
50
56
60
DISPLAY DEVICE
USER INTERFACE SELECTION DEVICE
62
KEYBOARD
64

FIG. 3

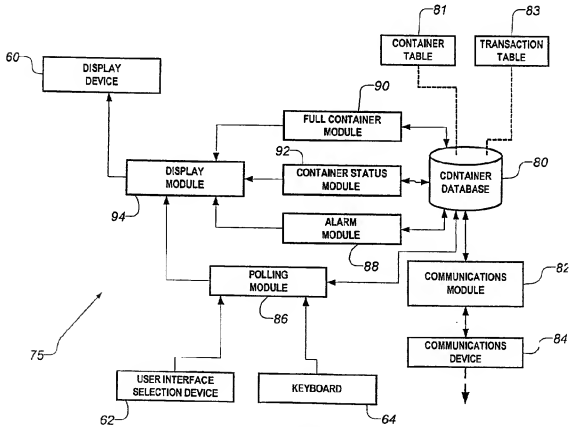

81
83
CONTAINER TABLE
TRANSACTION TABLE
60
DISPLAY DEVICE
90
FULL CONTAINER MODULE
92
DISPLAY MODULE
CONTAINER STATUS MODULE
CONTAINER DATABASE
80
94
ALARM MODULE
88
POLLING MODULE
COMMUNICATIONS MODULE
82
86
COMMUNICATIONS DEVICE
84
75
USER INTERFACE SELECTION DEVICE
KEYBOARD
62
64

FIG. 4

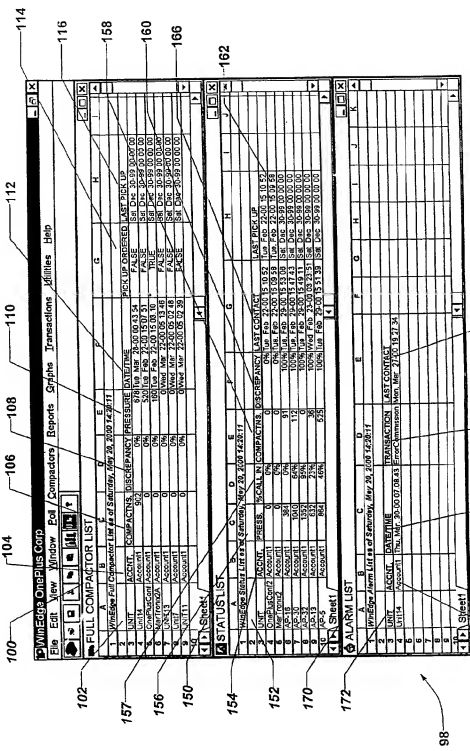

WinEdge OnePlus Corp
File Edit View Window Pcs Compactors Reports Grphs Transactions Utilities Help
FULL COMPACTOR LIST
STATUS LIST
ALARM LIST
Sheet1
100
102
104
106
108
110
112
114
116
150
154
156
157
158
160
162
166
170
172
174
176
178
180
98

FIG. 5

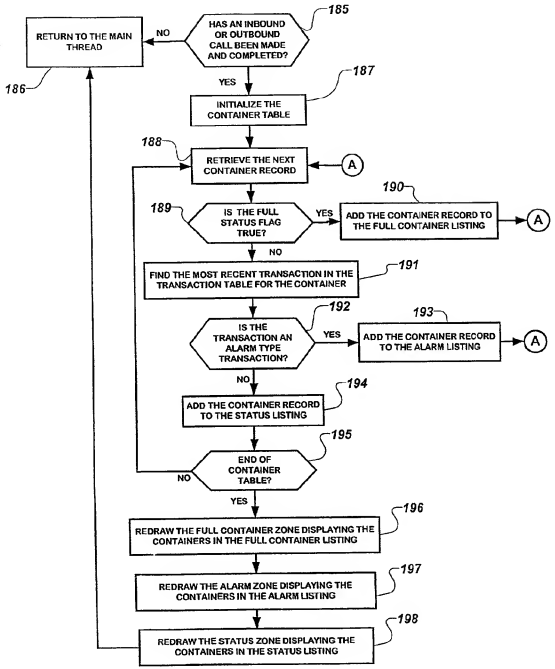

185
HAS AN INBOUND OR OUTBOUND CALL BEEN MADE AND COMPLETED?
NO
RETURN TO THE MAIN THREAD
186
YES
187
INITIALIZE THE CONTAINER TABLE
188
RETRIEVE THE NEXT CONTAINER RECORD
A
190
189
IS THE FULL STATUS FLAG TRUE?
YES
ADD THE CONTAINER RECORD TO THE FULL CONTAINER LISTING
A
NO
FIND THE MOST RECENT TRANSACTION IN THE TRANSACTION TABLE FOR THE CONTAINER
191
192
193
IS THE TRANSACTION AN ALARM TYPE TRANSACTION?
YES
ADD THE CONTAINER RECORD TO THE ALARM LISTING
A
NO
194
ADD THE CONTAINER RECORD TO THE STATUS LISTING
195
END OF CONTAINER TABLE?
NO
YES
196
REDRAW THE FULL CONTAINER ZONE DISPLAYING THE CONTAINERS IN THE FULL CONTAINER LISTING
197
REDRAW THE ALARM ZONE DISPLAYING THE CONTAINERS IN THE ALARM LISTING
198
REDRAW THE STATUS ZONE DISPLAYING THE CONTAINERS IN THE STATUS LISTING

FIG. 6

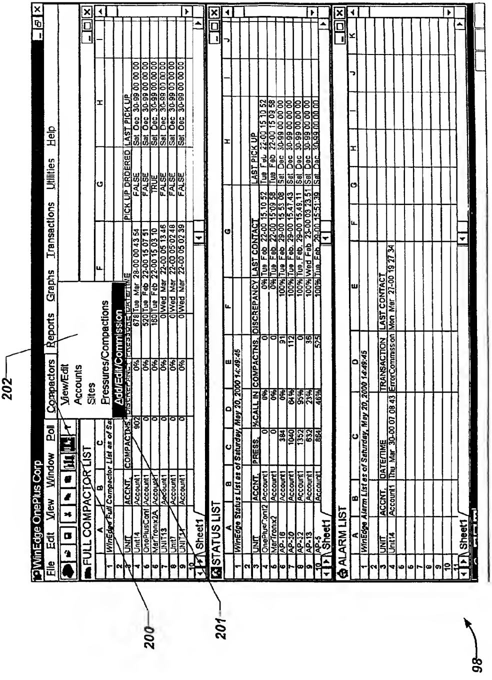


FIG. 7

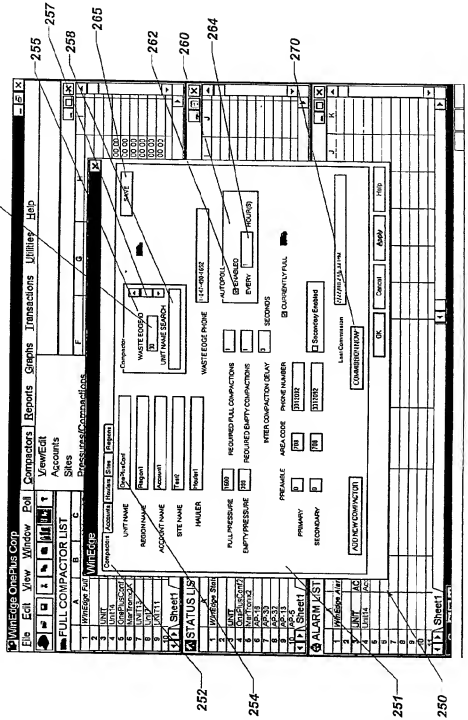

253
255
257
258
265
262
260
264
270
252
254
251
250
WinEdge Graphics Comp
File Edit View Window Poll Comparators Reports Graphs Transactions Utilities Help
FULL COMPACTOR LIST
Sheet1
STATUS LIST
ALARM LIST
Sheet1
Sheet1
WinEdge
Comparators
Accounts
Sites
Processes/Connections
UNIT NAME
REGION NAME
ACCOUNT NAME
SITE NAME
HAULER
FULL PRESSURE
EMPTY PRESSURE
REQUIRED FULL COMPACTIONS
REQUIRED EMPTY COMPACTIONS
INTER COMPACTION DELAY
PREFERRED AREA CODE
PHONE NUMBER
PRIMARY
SECONDARY
WASTE EDGE PHONE
AUTODIAL
ENABLED
ENTRY
SECONDS
CURRENTLY FULL
Secondary Enabled
Last Connection
COMMISSION DAY
ADD NEW COMPACTOR
OK
Cancel
Apply
Print

FIG. 8

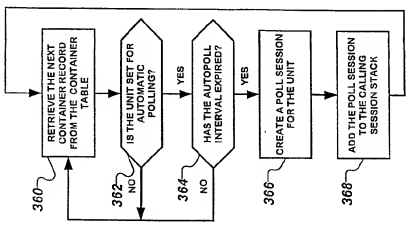


FIG. 9

POLLING SESSION

COMMAND TRANSMITTED FROM CENTRAL COMPUTER

TEXT REQUEST	RETRIES	TIMEOUT	DESCRIPTION
<U	02	3000	REQUEST CONTAINER UNIT NUMBER
<M	02	3500	REQUEST CONTAINER COMPACTION PRESSURE
<C	02	3500	REQUEST CONTAINER NUMBER OF COMPACTIONS
:H			HANG-UP

RESPONSE FROM MONITORING UNIT EXPECTED BY CENTRAL COMPUTER

TEXT RESPONSE	DESCRIPTION
> Uxx	UNIT NUMBER IS xx
> Mxx	PRESSURE IS xx
> Cxxx	COMPACTIONS ARE xxx

FIG. 12

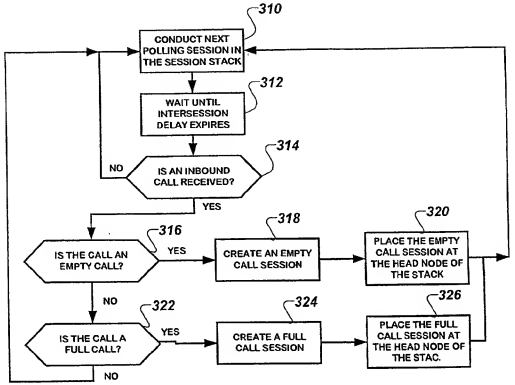

310
CONDUCT NEXT POLLING SESSION IN THE SESSION STACK
312
WAIT UNTIL INTERSESSION DELAY EXPIRES
314
IS AN INBOUND CALL RECEIVED?
NO
YES
316
IS THE CALL AN EMPTY CALL?
YES
318
CREATE AN EMPTY CALL SESSION
320
PLACE THE EMPTY CALL SESSION AT THE HEAD NODE OF THE STACK
NO
322
IS THE CALL A FULL CALL?
YES
324
CREATE A FULL CALL SESSION
326
PLACE THE FULL CALL SESSION AT THE HEAD NODE OF THE STAC.
NO

FIG. 10

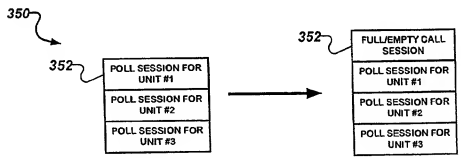

350
352
POLL SESSION FOR UNIT #1
POLL SESSION FOR UNIT #2
POLL SESSION FOR UNIT #3
352
FULL/EMPTY CALL SESSION
POLL SESSION FOR UNIT #1
POLL SESSION FOR UNIT #2
POLL SESSION FOR UNIT #3

FIG. 11

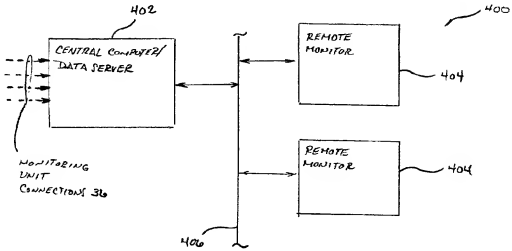

402
400
CENTRAL COMPUTER/ DATA SERVER
REMOTE MONITOR
404
REMOTE MONITOR
404
MONITORING UNIT CONNECTIONS 38
406

FIG. 13

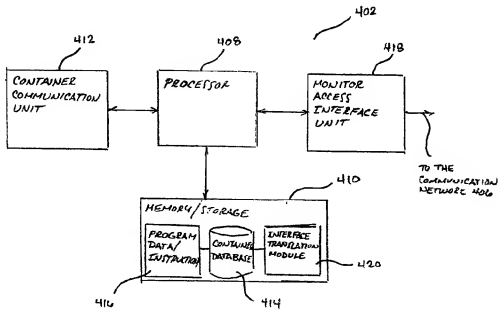

402
412
408
418
CONTAINER COMMUNICATION UNIT
PROCESSOR
MONITOR ACCESS INTERFACE UNIT
TO THE COMMUNICATION NETWORK 406
410
MEMORY/STORAGE
PROGRAM DATA/ INSTRUCTION
CONTAINER DATABASE
INTERFACE TRANSLATION MODULE
420
416
414

FIG. 14

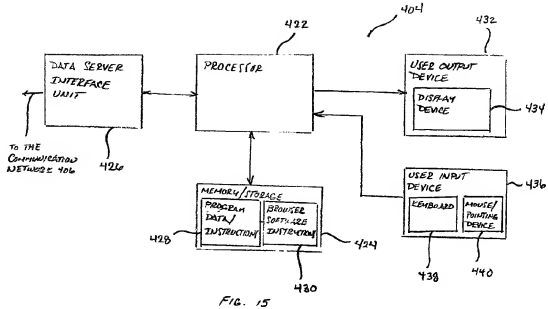

401
422
432
DATA SERVER INTERFACE UNIT
PROCESSOR
USER OUTPUT DEVICE
DISPLAY DEVICE
434
To THE COMMUNICATION NETWORK 406
426
MEMORY/STORAGE
PROGRAM DATA/ INSTRUCTION
BROWSER SOFTWARE INSTRUCTION
428
424
USER INPUT DEVICE
436
KEYBOARD
MOUSE/ POINTING DEVICE
438
440
430

FIG. 15

SYSTEMS FOR REMOTE MANAGEMENT OF A NETWORK OF WASTE CONTAINERS

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This is a continuation-in-part application of U.S. patent application Ser. No. 09/590,214, filed Jun. 8, 2000, entitled "SYSTEM FOR REMOTE MANAGEMENT OF A NETWORK WASTE CONTAINER", which claims priority from provisional U.S. patent application Ser. No. 60/188,612, entitled "USER INTERFACE," filed Mar. 7, 2000, the subject matter and entire writings of which are incorporated herein by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

REFERENCE TO A MICROFICHE APPENDIX

[0003] Not applicable.

TECHNICAL FIELD

[0004] The invention relates generally to waste collection and removal systems. More particularly, the invention relates to systems for monitoring and managing the status of a number of waste containers, such as trash compactors, which are equipped with compacting assemblies, or open-top containers which are not equipped with compacting assemblies, in a manner that permits a user to quickly determine at a central location the current status of all containers in the container network. The invention also relates to systems for managing communications between a central computer and a plurality of monitoring units, each located at a respective container site. The invention also relates to systems for permitting user-modified polling of such monitoring units.

BACKGROUND OF THE INVENTION AND TECHNICAL PROBLEMS POSED BY THE PRIOR ART

[0005] Much effort has been invested to provide efficient and economical systems for facilitating waste collection from a network of waste containers. Typically, one or more waste collection service providers, or haulers, will service a waste container network that includes a large number of waste containers situated at different geographical locations in a given region. Usually, these containers are provided with a compacting device equipped with a hydraulic ram for compacting the trash or, they may consist of open-top containers which are not equipped with a compacting device. When a container becomes full, a hauler, typically a large truck, is dispatched to the site to empty the container. Since each hauler trip typically involves significant cost, and since the amount of waste generated at a particular location typically varies in an unpredictable manner, the status of each container in the network is usually monitored in some way to ensure that haulers are dispatched to full containers in a timely and economical manner.

[0006] It is known to provide waste container monitoring systems that employ a respective processing or monitoring unit and a respective communications link associated with each waste container. Such systems are disclosed in U.S. Pat. No. 5,303,642, the entire writing and subject matter of which are incorporated herein by reference. These systems detect container fullness by monitoring the maximum pressure applied to the hydraulic ram during a compaction stroke. The monitoring unit includes a microprocessor for making a container status, i.e., fullness or emptiness, determination. When a full or empty container determination is made, the monitoring unit initiates an outbound call and a signal representing the container status is communicated via communications link to a remote central location. For example, the monitoring unit initiates an outbound call when it determines that the associated container is full and sends a facsimile message to a remote location to indicate to a human administrator that a particular container is full or empty.

[0007] Other prior art systems, such as those disclosed in U.S. Pat. No. 5,016,197, provide an automated trash management system to monitor the fullness of a plurality of trash compactor/container units based upon an analysis of the number of cycles of the compactor and the hydraulic pressure associated therewith. Such systems utilize a monitoring unit that includes a pressure sensing unit associated with each waste container. The monitoring unit transmits data, representing instantaneous hydraulic pressures, to a central computer via communications link, such as a telephone system. The central computer determines the fullness of each trash compactor based on the transmitted pressure data. The computer may compile a database for each trash compactor and compactor fullness may be determined from the database.

[0008] As waste container networks grow in size, the management of the status information provided for each container in the container network becomes increasingly difficult. A human administrator of the container network is presented with and/or required to manage a great deal of information. Thus, a determination of which containers require immediate attention, i.e., which containers require emptying or are experiencing an error condition, often becomes overly burdensome. Accordingly, those of ordinary skill in the art will recognize a need for a system for facilitating the efficient management of a waste container network by providing comprehensive information in a manner that permits a human user to quickly and accurately determine the status of all containers in a container network. Moreover, there is a need for a system that is versatile in that it is compatible with monitoring units which make a fullness determination at the container site and with monitoring units which provide information used to make a fullness determination at a central computer.

[0009] Another problem with prior art waste container management systems is that they do not provide for real-time dynamic updating of container status. Nor do they provide for user-controlled polling of the containers in the network. For example, in systems such as the one disclosed in U.S. Pat. No. 5,016,197, where pressure readings are conveyed to a central computer, the central computer typically conducts polling of a particular container according to a preset and rigid schedule. Thus, in cases where a user desires immediate information about a container's status, the information is not readily available until the container is polled by the system. Another related consequence of the prior art polling techniques is that the information presented to the user may not be accurate or up to date. Thus, it would

be desirable to provide a waste management system which provides for real-time dynamic updating of container status and which permits a user to modify or control the polling schedule associated with particular containers.

[0010] Yet another problem with prior art waste container management systems is that they do not provide for efficient updating of container status information. In a typical prior art container network, the monitoring units will typically be adapted to make outbound calls to a central computer to report container status information. In addition, the central computer may be adapted to make outbound calls according to an automatic polling routine to update container status. However, if outbound calls are being made, the receipt of an inbound call from a full container in prior art systems may be prevented or delayed, especially in systems that provide only a single communications channel, resulting in outdated information being presented to the user. Thus, the prior art does not provide an efficient method for managing inbound and outbound calls in a manner that provides for efficient updating of container status information. Accordingly, there is a need for such a system.

SUMMARY OF THE INVENTION

[0011] The benefits and advantages described above are realized by the present invention which provides a system for remotely managing a network of waste containers in a container network which provides comprehensive container network information to a user in a manner that enables the user to quickly and accurately determine the status of all containers in the container network. In a preferred embodiment, the invention provides a central computer having a communication link to each of the monitoring units for the respective containers in the container network. Communications with the monitoring units in the container network are managed by a communications module on the central computer. The central computer is adapted to provide a dynamically updated display which distinguishes full containers from other containers in the network. In a preferred embodiment, the invention provides a graphic display with a full container window or zone in which identifiers for the full containers displayed, along with other information, such as container location, pressure and compaction readings, account information and contact information for the waste collection service or hauler associated with the container. The display is provided by a display module in conjunction with a full container module which cooperates with a container database to determine which containers in the container network have reported full status and periodically redraws the full container zone or window to provide an updated list of full containers.

[0012] The container database preferably includes a container table and a transaction table. The container table is a relatively static database containing a container record for each container in the network. Each container record includes a container identifier and various information associated with the container, including operating parameters, accounting information and geographical location. In a preferred embodiment, the container record includes a full status flag which is used to indicate whether a fullness determination has been made by the monitoring unit associated with the container and communicated to the central computer. Alternatively, the container record may include a pressure threshold and a fullness determination may be made at the central computer. The transactions table is a relatively dynamic database and contains transaction records resulting from each communication session attempted or established with a monitoring unit in the container network. Each transaction record contains information identifying the associated container, as well as information identifying the type of transaction resulting from the communication attempt with the monitoring unit associated with the container.

[0013] The invention also provides an alarm zone or window for distinguishing to the user which containers in the container network have an alarm condition. The transaction table is adapted to contain transaction types that include errors that occur during communication attempts. An alarm module cooperates with the transaction table to determine which containers have an alarm condition and, in conjunction with the display module, provides a graphic display listing identifiers for the containers with an alarm condition. Like the full container module, the alarm module periodically reviews the container database and updates the alarm zone or window to reflect the current status of the containers in the container network.

[0014] The invention also provides a container status zone or window for displaying the non-full containers which do not have an alarm condition. A container status module cooperates with the transaction table to determine which containers are neither full nor have an alarm condition and, in conjunction with the display module, provides a graphic display listing identifiers for the containers that are neither full nor have an alarm condition.

[0015] The full container zone, alarm zone and container status zone of the invention provide a simple and efficient way for an operator to quickly determine the status of all containers in the container network. Moreover, the full container zone distinguishes full containers from the rest of the containers in the container network such that the user may quickly determine which containers are in need of emptying. Similarly, the alarm zone distinguishes containers having an alarm condition from the rest of the containers in the network and permits quick determination by a user of containers experiencing an error condition.

[0016] According to yet another feature of the invention, automatic polling may be scheduled by the user. Polling involves an outbound call or communication initiated by the central computer to the monitoring unit for a selected container in the container network. A polling module provides a user interface to enable a user to enter polling parameters and the polling module updates the container database accordingly. The container records stored in the container table preferably contain fields for an automatic polling flag and a polling interval. The polling module accepts user input and stores the appropriate automatic polling data in the container record. The communications module is adapted to periodically review the container table and schedule polling sessions according to the parameters in the automatic polling flag and polling interval fields in the container records. Preferably, the polling sessions are queued into a session stack on a first-in-first-out basis. In this manner, the user can control the polling interval for each container in the container network. Moreover, the session stack permits scheduled polling sessions, as well as on-demand polling sessions requested by the user, to be queued

such that the user need not be present for the polling sessions to be performed. The communications module conducts polling of the containers in the network in a manner that is preferably transparent during the user's observation of the full container zone, container status zone and alarm zone. The communications module is preferably implemented as a communications thread that is separate from and executed in the background relative to the main thread of execution represented by the operation of the full container module, container status module and alarm module.

[0017] According to yet another feature of the invention, the communications module is adapted to manage the scheduling and execution of polling sessions while permitting the receipt of inbound full or empty calls initiated by monitoring units in the container network. The communications module provides a waiting period or delay between the execution of scheduled polling events to permit receipt of inbound calls. Preferably, the receipt of an inbound call preempts the polling events already queued in the session stack such that the calling session associated with the inbound call is performed immediately. This ensures that inbound calls from monitoring units, for example, inbound calls indicative of a full container in the network, result in immediate updating of the container database and immediate appropriate updating of the full container zone, container status zone or alarm zone.

[0018] According to yet another feature of the invention, the container status information could is accessible via one or more remote monitors, which are communicatively coupled to central computer, thereby enabling remote user access. In at least one aspect of the feature, the communication occurs via a global public wide area communication network.

[0019] Numerous other advantages and features of the present invention will become readily apparent from the following detailed description of the invention, from the claims, and from the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] In the accompanying drawings that form part of the specification, and in which like numerals are employed to designate like parts throughout the same,

[0021] **FIG. 1** is a block diagram showing the basic elements of a waste compacting unit according to a preferred embodiment of the invention;

[0022] **FIG. 2** is a block diagram of a waste container network according to a preferred embodiment of the invention;

[0023] **FIG. 3** is a block diagram of the basic components of a computer suitable for implementing an exemplary system according to a preferred embodiment of the invention;

[0024] **FIG. 4** is a block diagram depicting the relationships between the various modules and databases associated with an exemplary embodiment of the present invention;

[0025] **FIG. 5** depicts an exemplary display of a full container zone, a container status zone, and an alarm zone according to a preferred embodiment of the present invention;

[0026] **FIG. 6** is an exemplary flow diagram of the steps performed by an exemplary full container module, container status module and alarm module according to the invention to render and update a display such as the one shown in **FIG. 5**;

[0027] **FIG. 7** depicts an exemplary display of a menu option enabling a user to access a container parameter editing function according to a preferred embodiment of the present invention;

[0028] **FIG. 8** depicts an exemplary display of a container parameter dialogue window or pane according to a preferred embodiment of the present invention;

[0029] **FIG. 9** depicts a flow chart showing the steps performed by an exemplary communications module and polling module to create poll sessions according to the invention;

[0030] **FIG. 10** depicts a flow chart showing the steps performed by an exemplary communications module to permit receipt of inbound calls while conducting calling sessions scheduled in a calling session stack according to a preferred embodiment of the invention;

[0031] **FIG. 11** is a schematic illustration of a session stack used to determine container status according to the invention;

[0032] **FIG. 12** is a diagrammatic illustration representing a data exchange between a monitoring unit and a central computer during a polling session in an exemplary system according to the invention;

[0033] **FIG. 13** depicts the remote access portion of one exemplary system for remotely managing a waste container network including a central computer/data server and one or more remote monitors;

[0034] **FIG. 14** is a simplified block diagram of one embodiment of the central computer/data server, illustrated in **FIG. 13**; and

[0035] **FIG. 15** is a simplified block diagram of one embodiment of a remote monitor, illustrated in **FIG. 13**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0036] While this invention is susceptible of embodiment in many different forms, this specification and the accompanying drawings disclose only some specific forms as examples of the invention. The invention is not intended to be limited to the embodiments so described. The scope of the invention is pointed out in the appended claims.

[0037] Referring to **FIG. 1**, a typical waste container, generally depicted by the reference numeral **10**, includes a container **12**, equipped with a compacting assembly having a hydraulic driver **16** which includes a ram **14**, to compact waste received in container **12**. The hydraulic driver **16** receives pressurized hydraulic fluid via hydraulic lines **17** to effect reciprocal movement of the ram **14** in a controlled manner using a shuttle valve **18**. Hydraulic fluid is stored in a reservoir **20** which provides pressurized hydraulic fluid to the shuttle valve **18** and which is returned from the shuttle valve **18** via a return line **21**. As will be recognized by those of ordinary skill, the reservoir **20**, pump **22**, shuttle valve **18** and return line **21** form a hydraulic circuit **23**. The afore-

mentioned container structure is well known in the art and the details thereof, which are set forth in U.S. Pat. No. 5,303,642, are not necessary for an understanding of and do not form a part of the present invention.

[0038] A monitoring unit, generally referenced by the numeral **38**, provides an indication of the status of container **10**. For example, the monitoring unit **38** may comprise a pressure transducer **26** disposed in the hydraulic circuit **23** at the outlet of the pump **22** to generate a signal (P) representing the hydraulic pressure being applied to the hydraulic driver **16**. The signal (P) is conveyed to a status processor **42**, which preferably includes a microprocessor based computer executing appropriate instructions for determining container status based on the signal (P) and generating a container status signal (S), representing status information associated with the container **10**. For example, the monitoring unit **38** may determine container status locally according to the method disclosed in U.S. Pat. No. 5,303,642 by determining the maximum pressure experienced by the transducer **26** during a compaction stroke of the ram **14**, wherein the container status signal (S) represents a status flag indicating the full status of the container. Alternatively, the monitoring unit **38** may operate according to the system described in U.S. Pat. No. **5,016,197** and provide status information representative of hydraulic pressures historically applied to the hydraulic driver **14**, wherein the status information is communicated to a central computer and the container status is determined remotely from the container. The monitoring unit **38** also includes a communication device **44**, such as a modem, in communication with the status processor **42** through a communications interface **32**. Communications device **44** conveys the status signal (S) via a communications link **36**, which may comprise a wire-based communication system, such as a telephone network, or a wireless communication system.

[0039] **FIG. 2** illustrates an exemplary container network according to a preferred embodiment of the present invention. A number of container **12**A, **12**B, **12**C and **12**D, each having respective monitoring units **38**A, **38**B, **38**C and **38**D communicate with a central computer **50** via communication links **36**A, **36**B, **36**C and **36**D. It will be understood by those of ordinary skill in the art that the present invention is applicable to container networks having more than four containers and respective monitoring units. Typically, the number of containers in a container network may exceed one hundred.

[0040] **FIG. 3** illustrates the basic components of an exemplary central computer **50** suitable for implementing the system according to the invention. The central computer **50** includes a microprocessor **52** and memory **54**, interconnected for electrical communication through a system bus **56**. A storage device **58**, which may typically include well-known storage devices, such as magnetic or optical disks, is also in communication with system bus **56**. As is well-known in the art, memory **54** will contain digital data representing instructions for microprocessor **52**. Storage device **58** may also include such instructions or data. Computer **50** also includes user-interface devices for enabling a user to interact with the computer **50**. A display device **60**, which typically comprises a cathode ray tube or liquid crystal display, communicates with the system bus **56** and displays graphical information to the user according to instructions executed by the microprocessor **52**. A user interface selection device **62** also communicates with the system bus **56** and may include a mouse or other pointing device. A keyboard **64** is also in communication with the system bus **56** to permit user-entry of alpha-numeric information.

[0041] **FIG. 4** illustrates the basic components or modules of an exemplary system according to the invention. Those of ordinary skill in the art will understand that these modules or components are preferably implemented as a series of instructions for microprocessor **52** and stored in a computer-readable medium, such as memory **54** or storage device **58**.

[0042] An exemplary system **75** according to the invention, includes a container database **80** that contains various information relative to each of the containers in the container network. The container database is preferably a relational database compatible with a commercial relational database management application such as "ACCESS" developed by Microsoft Corporation, of Redmond, Wash. It will be understood by those of ordinary skill that the container table **81** and a transactions table **83** described herein are preferably in the form of separate but related databases contained in the generically referenced container database **80**.

[0043] The container table **81** includes a number of container records corresponding to the number of containers in the container network. Each record contains various kinds of information associated with the respective container, as will be explained below. The container database also preferably includes a transaction table **83**, including a number of transaction records, each reflecting a transaction conducted relative to one of the containers in the container network as will be explained in more detail below. A transaction record is created in the transactions table **83** by the communications module **82** each time a communications session is established with a monitoring unit **38** in the container network. Thus, the container database **80** is kept updated by the communications module **82**, which interfaces with a communication device **84**, such as a modem and which manages communications sessions with the monitoring units **38** in the container network.

[0044] A full container module **90** retrieves information from the container database **80** and provides a signal to a display module **94**, which contains appropriate instructions and drivers to provide a signal readable by the display device **60**. Full container module **90** in conjunction with display module **94** preferably function to generate a full container window or zone displaying a list of the full containers in the container network, as will be explained in more detail below. The full container module **90** is adapted to determine when new transaction records have been created and to send appropriate signals to the display module **94** to update the list of full containers displayed in the window or zone.

[0045] An alarm module **88** retrieves information from the container database **80** regarding containers that have an alarm condition. For example, an alarm condition may occur when a status signal has not been or cannot be received from a particular container in the container network. In conjunction with display module **94**, alarm module **88** displays an alarm window or zone listing containers which have an alarm or error condition, as will be explained below.

[0046] A container status module **92** retrieves information from the container database **80** regarding the status of all

containers in the container network which are not full or which do not have an alarm condition. The container status module **92**, in conjunction with display module **94**, displays a window or zone which depicts the status of non-full containers that do not have an alarm condition, as will be explained in more detail below.

[0047] An exemplary container table **81** includes a number of container records with each record corresponding to a container in the container network. Each record in the container table **81** includes a number of fields containing various information relative to the container associated with the record. An exemplary container record is depicted below in TABLE A, with field names and an explanation of the information stored in the respective fields.

TABLE A

Container Record Field Name	Description
CONTAINER ID	A numeric identifier for the container.
UNIT NAME	A user-assigned name given to the container.
AUTO-POLL	A numeric value that indicates the interval at which automatic polling is set to occur.
INTERVAL	
AUTO-POLL FLAG	A flag that indicates whether the automatic polling has been designated for this container.
FULL STATUS FLAG	A flag that indicates whether or not the monitoring unit associated with the container has reported a full condition.
FULL STATUS ACKNOWLEDGMENT FLAG	Indicates whether the operator has acknowledged the full status of the container.
SOFTWARE SERIAL NUMBER	Indicates the serial number or version of the software/firmware running on the monitoring unit associated with the container.
CONTAINER SITE ID	An identifier reflecting the container site.
REGION ID	An identifier for a user-defined region in which the container is located.
ACCOUNT ID	An identifier for a billing account associated with the container.
HAULER ID	An identifier for a hauler contracting to empty the container.
CONTAINER PHONE NO.	A telephone number for contacting the monitoring unit associated with the container.
SERVICE CO. ID	An identifier for the service company associated with the container.
CONTAINER MFR	An identifier for the manufacturer of the container.
CONTAINER MODEL	An identifier for the model of the container.
MONITORING UNIT STATUS ID	An identifier reflecting the status of the monitoring unit associated with the container.
USER NOTE	A field for user-entered notes associated with the container.
EMPTY PRESSURE	A numeric value for an empty pressure threshold associated with the container and set during the commissioning process.
FULL PRESSURE	A numeric value for a full pressure threshold associated with the container (set during the commissioning process).
¾ PRESSURE	A numeric value for a ¾ pressure threshold associated with the container (set during the commissioning process).
½ PRESSURE	A numeric value for a ½ pressure threshold associated with the container (set during the commissioning process).
¼ PRESSURE	A numeric value for a ¼ pressure threshold associated with the container (set during the commissioning process).
REQUIRED FULL COMPACTIONS	A numeric value for the number of full compactions to be detected before the container is determined to have a full condition (set during the commissioning process).
REQUIRED EMPTY COMPACTIONS	A numeric value for the number of full compactions to be detected before the container is determined to have an empty condition (set during the commissioning process).
INTER-COMPACTION DELAY	A numeric value designating the time between compactions (set during the commissioning process).
PRIMARY PREAMBLE	A first DTMF digit used by the monitoring unit to access an outside phone line.
SECONDARY PREAMBLE	A DTMF digit used by the monitoring unit to access an outside phone line.
PRIMARY PHONE NUMBER	A primary phone number the monitoring unit dials upon a change in status (e.g. full or empty).
DIAL SECONDARY FLAG	A status flag indicating whether or not the monitoring unit makes a second call.
SECONDARY PHONE NUMBER	A secondary phone number the monitoring unit dials upon a change in status
LAST CONTACT TIME	The date and time the last communication was established with the container.
PULL COST	The cost associated with an emptying operation for the container.
PULL PRICE	The price charged for emptying the container.
CURRENT PRESSURE	A numeric value reflecting the latest pressure reading by the monitoring unit associated with the container.
CURRENT COMPACTIONS	A numeric value reflecting the number of compactions determined by the monitoring unit since the last container pick-up.
AVERAGE COMPACTIONS	A numeric value reflecting the average number of compactions undergone between container emptying and a full container determination.
PICK UPS	The number of pick-ups performed by a hauler for the container.
TOTAL COMPACTIONS	The total number of compactions performed on the container.
COMMISSION DATE	The most recent date that a commissioning process was performed on the container.
INSTALL DATE	The date the container was installed at the site.
FIRMWARE VERSION	The version of the firmware in the monitoring unit associated with the container

[0048] It will be recognized that a record in the format of the one depicted in TABLE A will be stored in the container database for each of the containers in the container network.

[0049] It will be noted that some of the container record fields described in TABLE A refer to a "commissioning process." Although not limited to use in such container network systems, the invention is adaptable to container network systems such as those described in U.S. Pat. No. 5,303,642 where the monitoring units **38** may be commissioned from a remote location. The term "commissioning" refers generally to a process by which internal settings, such as values designating full pressure thresholds, of the monitoring unit are modified from a remote location. Since such systems make a container fullness determination at the container site, it is useful to provide for the remote modification of criterion used to make the fullness determination, for example, the maximum compactor pressure permitted before a full determination is made.

[0050] Referring again to TABLE A above, in applications where some or all of the containers in the container network are equipped with compactors, the container table may contain data representing certain pressure thresholds that are set during the commissioning process for that particular container. For example, the full pressure setting, empty pressure setting, ¾, 12 and ¾ pressure thresholds may be

stored in the container table. A commissioning process may be performed by the central computer in which the stored values are communicated to the monitoring unit for the associated container so that ⅜, ½ and ¼ pressure flags may be set on the monitoring unit and conveyed to the central computer. Typically, the commissioning process will involve a data exchange, which may involve an ASCII or similar protocol to communicate the pressure thresholds to the software or firmware at the monitoring unit in a manner similar to the manner in which container identification and status information are communicated as explained below.

[0051] The container database **80** also preferably include a transactions table **83**, which contains records of transactions conducted relative to each of the containers in the container network. As will be explained in more detail below, a transaction record is created in the transactions table **83** by the communications module **82** each time a communications session is established, either by a polling session in the form of an outbound call initiated by the communications module or by the receipt of an inbound call initiated from a monitoring unit associated with a container in the container network. An exemplary transactions record is illustrated below in TABLE B.

TABLE B

TRANSACTION RECORD FIELD NAME	DESCRIPTION
TRANSACTION ID	A numerical value signifying an internal transaction identifier assigned by the communications module (for example, sequential integers).
CONTAINER IDENTIFIER	A numerical value identifying the monitoring unit associated with the transaction.
MONITORING UNIT SERIAL NUMBER	An identifier for the monitoring unit associated with the transaction.
DATE STAMP	The date and time of the transaction.
TRANSACTION TYPE IDENTIFIER	An identifier of the type of transaction.
PRESSURE READING	A pressure reading obtained during the transaction.
COMPACTION COUNT	A compaction count obtained during the compaction.
WEIGHT	The weight of the container at the time of the transaction.

[0052] As described above, each transaction record preferably includes a field named TRANSACTION TYPE IDENTIFIER which contains data, either a text string or, alternatively a numeric code, representing the type of transaction, or the type of error occurring as a result of a communications session. An exemplary listing of transaction type strings suitable for implementing the invention appear in TABLE C below.

TABLE C

TRANSACTION TYPE STRING	DESCRIPTION
FULL	The transaction was created as a result of a full call initiated by the monitoring unit associated with the container.
EMPTY	The transaction was created as a result of an empty call initiated by the monitoring unit associated with the container.

TABLE C-continued

TRANSACTION TYPE STRING	DESCRIPTION
POLLAUTO	The transaction was created as a result of an automatic polling session scheduled by the user.
POLLDEMAND	The transaction was created as a result of an on-demand poll requested by the user.
COMMISSION	The transaction was created as the result of a commissioning process performed on the monitoring unit.
RESET	A user initiated session forcing the container status to be empty.
POLLFULL	The transaction was created as a result of a full container sensed as a result of a polling session.
POLLEMPTY	The transaction was created as a result of an empty container senses as a result of a polling session.
ERRORFULL	An error occurred during a full call session.
ERROREMPTY	An error occurred during an empty call session.
ERRORCALLIN	A container attempted to call but did not finish the session, typically due to excessive phone line noise.
ERRORPOLLAUTOBUSY	The line was busy during an automatic polling session.
ERRORPOLLDEMAND BUSY	The line was busy during an on-demand polling session.
ERRORPOLLAUTO	An error occurred during an automatic polling session.
ERRORPOLLDEMAND	An error occurred during an on-demand polling session.
ERRORCOMMISSION	An error occurred during a commissioning session.
ERRORRESET	A user-initiated reset session was attempted but failed to complete.
ERRORBADTRANSDUCER	A bad transducer has been detected on the monitoring unit.
ERRORUNKNOWNFULL	An unknown error occurred during a full call
ERRORUNKOWNEMPTY	An unknown error occurred during an empty call.

[0053] Those of ordinary skill in the art will recognize that the transaction table provided by the present invention provides a transaction history of all activity in the container network. As such, the invention provides for the presentation of historical data for a particular container to the user. For example, a graph of historical pressure readings obtained by periodic polls of a particular container may be presented to the user in graphical form by iterating through the transaction table and retrieving transaction records having the AUTOPOLL transaction type for a selected container. These transaction records may be stored in a designated table and a graph generated from the pressure readings and respective date stamps.

[0054] In systems adhering to the teachings of U.S. Pat. No. 5,303,642, in which the container fullness determination is made at the container site, an inbound call is initiated by the monitoring unit **38** when the container reaches a full condition. As will be explained in more detail below, the communications module **82** manages the receipt of inbound calls from monitoring units **38** in the container network. The monitoring unit **38** is configured to set a full status flag when a full condition has been determined, based on recent compaction and pressure history and iteration counts. Upon detection of a full condition and setting of the appropriate

status flag, the monitoring unit **38** initiates a telephone communication to the central computer **50**. When a communications link is established, a communications session occurs and the monitoring unit uploads information about the container status and identification. In addition to receiving the uploaded information, the central computer **50** may request additional information from the monitoring unit **38**. For example, a 7-bit ASCII format may be used to communicate commands according to the protocol as represented in TABLE D below.

TABLE D

Command	Description/Meaning
<F01	The monitoring unit indicates that a "full" command or status flag is set on the container unit designated "01"
<C064	The monitoring unit indicates that the current number of compactions is 064 (hexadecima) or 100 (decimal)
>M	The central computer requests the current pressure from the status monitor
<M56	The monitoring unit responds that the current pressure is 80 (hexadecimal) or about 1000 psi

[0055] In accordance with an primary feature of the invention, the compactor database is dynamically updated with information from the container network received by the communications module **82**, which is adapted to receive inbound communications initiated at container sites and which, in a polling operation, is also adapted to initiate outbound communications to one or more containers in the container network. Communications module **82** cooperates through a communications interface with a communications device **84**, such as a modem, to receive and transmit data. A polling module **86** provides for user-modified polling actions in a manner that will be explained in more detail below.

[0056] Referring to **FIG. 5**, there is illustrated an exemplary display generated by display module **94** in conjunction with the full container module **90**, container status module **92** and alarm module **88**. An exemplary graphical representation of a full container zone preferably takes the form of a full container window **100** displaying a listing of full containers in a spreadsheet format. In accordance with well known operating systems, the full container zone **100** may be displayed within a main window **98**. Full containers are identified by a unit identifier presented in a UNIT column **102**. The unit identifier may be a text string assigned by the user. An account column **104** provides information regarding the business account associated with respective unit identifiers. A compactions column **106** contains information regarding the number of compactions performed on the container by a compacting apparatus, such as that described with respect to **FIG. 1**. The compactions information may be provided to the container database **80** through the communications module **82** which may receive an inbound call or data signal from a monitoring unit **38** associated with the container to indicate the number of compactions performed on the container. A discrepancy column **160** provides information regarding the discrepancy existing between the current number of compactions and a running average of compactions required for a "full" event. The discrepancy column **160** provides an indicator in the container status zone or window of an impending "full" condition so as to facilitate an early pick up if so desired by the user. For example, the discrepancy may be calculated as follows:

DISCREPANCY=[(Average No. of Full Compactions−Current No. of Compactions)/Average No. of Full Compactions]×100

[0057] A pressure column **110** displays values representing the last hydraulic pressure measured in the hydraulic circuit associated with the ram of a compactor for a respective container. Pressure values are determined from the container database which is dynamically updated, as will be explained below, with data from the monitoring unit associated with the respective compactor. A date/time column **112** displays the data and time that the last pressure and compactions data were obtained. A pick-up ordered column **114** contains information representing to the user whether a pick-up has been scheduled for the particular container. A last pick-up column **116** displays information for the user's reference as to when the last pick-up occurred for the particular container. Those of ordinary skill will recognize that the full container zone **100** provides a visual indication to the user as to which containers in the container network are in need of being emptied.

[0058] As will be appreciated, some container monitoring units, such as those disclosed in U.S. Pat. No. 5,303,642, make a container fullness determination on-site, at the location of the container, and provide a fullness indication signal via the communications link. Upon detection of a "full" condition, such monitoring units initiate a phone call to the central computer **50** and convey a full command to the central computer. Thus, when applied to container networks in which the monitoring units initiate a "full" call to a central location, the invention provides for a full container zone **100** that displays identifiers and other operational information associated with containers, the monitoring units of which have initiated "full" calls. Alternatively, where the invention is applied to container networks in which the monitoring units provide pressure data to a central location and a fullness determination is made at the central location, the full container zone **100** may be used to provide a visual indication of full containers based on fullness determinations made at the central computer **50**.

[0059] Still referring to **FIG. 5**, in accordance with another feature of the invention, a container status zone or window **150** is also displayed to the user within the main window **98**. An exemplary graphical representation of container status zone **150** preferably takes the form of a container status window displaying a listing of containers in the container network in a spreadsheet format. In a manner similar to the full container zone **100** described above, the container status zone **150** provides a unit identifier column **152**, an account information column **154**, a pressure reading column **156**, a % CALL IN column **157**, a compactions column **158**, a discrepancy column **160**, a last contact column **166**, and a last pick-up column **162**. The % CALL IN column **157** provides an indication of the percentage represented by the current pressure compared to a threshold "call-in" pressure. The "call in" pressure represents a pressure value at which a fullness determination is made by the monitoring unit **38**. The last column **166**, indicates to the user when the last contact was made relative to the listed containers.

[0060] Also illustrated in **FIG. 5** and in accordance with another feature of the invention, an alarm zone or window

170 is provided for depicting to the user a list of containers in the container network which are currently experiencing an alarm condition. Such alarm conditions may include a failure of a particular monitoring unit in the container network to report (or make an inbound call) to the central computer or a failure of a pressure transducer in the monitoring unit associated with a particular container. This alarm information is provided to the container database by the monitoring units associated with containers in the network. Preferably, this information is obtained during an outbound polling session initiated by the central computer as will be explained below. Alternatively, the monitoring units may be equipped with appropriate control routines to send a signal to the central computer to indicate a particular failure of a component, such as a pressure transducer. A unit identifier column **172**, account column **174**, date/time column **176** and last contact column **178** are preferably displayed in the alarm zone **170**. In addition, a transaction column **180** provides an indicator, such as a text string, for revealing to the user the type of error or alarm experienced with respect to a particular container.

[0061] The information presented in the full container zone **100**, container status zone **150**, and alarm zone **170** is retrieved from the container database **80** by the full container module **90**, container status module **92**, and alarm module **88**, which are adapted to recognize the creation of new transactions in the container database **80** by the communications module **82** or otherwise as will be described. Moreover, as will be described in more detail below, the full container zone **100**, container status zone **150** and alarm zone **170** are continuously updated based on information received by communications module **82** and written to database **80**. When new data is received, the full container module **90** redraws the full container zone **100** to update the display. Similarly, the container status module **92** redraws the container status zone **150** and the alarm module **88** redraws the alarm zone **170**.

[0062] **FIG. 6** is a flow diagram illustrating the steps of operation of an exemplary process performed by the full container module, status module and alarm module to maintain an updated listing of full containers, container status and containers having an alarm condition, respectively.

[0063] The exemplary process is preferably performed upon the completion of an inbound call received from a reporting monitoring unit **38** or upon completion of an outbound call initiated by the communications module **82** as a result of an on-demand poll initiated by the user or as a result of a polling session scheduled by the user. The main thread of execution includes steps to check for the completion of an inbound or outbound call, represented generally at step **185**. This check may be implemented, for example, as a program message routed or threaded through the operating system associated with the communications device or modem **84**. If it is determined that neither an inbound nor an outbound call has been completed, the process branches to step **186** and returns to the main thread.

[0064] If at step **185** it is determined that an inbound or outbound call has been completed, the process initializes the container table, for example, setting a pointer to the first record in the container table, at step **187**. At step **188**, the next container record (in the case of the first iteration, the first container record in the container table) is retrieved by the full container module **90**. At step **189**, a determination is made as to whether or not the full status flag, in the field FULL STATUS FLAG in the container record is set to a "true" value, indicating the monitoring unit **38** associated with the container has reported that the container is full. If so, the process branches to step **190** where the container record is added to a full container listing temporarily stored in memory. The process then returns to step **188** where the next container record is retrieved from the container table.

[0065] If at step **189**, it is determined that the full status flag of the container record is not true, the process continues to step **191** where the transaction table is examined by the alarm module **88** to determine the most recent transaction associated with the container (i.e., having the identifier for the container in the UNIT IDENTIFIER field). At step **192**, a determination is made as to whether the most recent transaction is an alarm type transaction, for example, an ERRORFULL or ERRORBADTRANSDUCER transaction type contained in the TRANSACTION TYPE IDENTIFIER field of the transaction record. If so, the container record is added to an alarm listing temporarily stored in memory at step **193**. The process then returns to step **188** where the next container record is retrieved.

[0066] If at step **192**, it is determined that the most recent transaction is not an alarm type transaction, then the process continues to step **194** where the container record is added to a status listing temporarily stored in memory. At step **195**, the process determines whether or not the end of the container table has been reached. If not, the process branches back to step **188** to retrieve the next container record. If so, the process continues to step **196** where the full container module **90**, in conjunction with the display module **94**, redraws the full container zone to display the listing of full containers stored in the full container listing. Similarly, at step **197**, the alarm module **88** in conjunction with the display module **94**, redraws the alarm zone to display the listing of containers stored in the alarm listing. Likewise, at step **198**, the container status module **92**, in conjunction with the display module **94**, redraws the container status zone to display the listing of containers in the status listing. The process then returns to the main thread of execution at step **186**.

[0067] As will be recognized from the exemplary process described above, a given container in the container network appears in only one place on the display **98**. That is, a given container is identified either in the full container zone, the alarm zone or the container status zone. Accordingly, a user may quickly determine which of the containers in the container network are full by viewing the full container zone, which also provides key information as described relative to **FIG. 5**. Similarly, the existence of any alarm conditions on containers in the network may be quickly determined by viewing the alarm zone. The status of the remaining containers in the container network—those that have neither a full condition or an alarm condition—may be quickly determined from the container status zone. With each instance of an inbound or outbound call, the full container module **90**, container status module **92** and alarm module **88** operate to update the display to reflect changes in the status of the containers in the network. Thus, the user is presented with an up-to-date display which permits quick determination of the status of all active containers in the container network.

[0068] Referring now to **FIG. 7**, according to another aspect of the invention, a user interface is provided for permitting a user to set and modify the automatic polling parameters for particular containers in the container network. In response to user activation of the user interface selection device **62 (FIG. 3)**, or in response to appropriate alpha-numeric entry through keyboard **64 (FIG. 3)**, a COMPACTORS feature **200** displayed in the main window **98** may be activated to provide a pull-down display **202**, which includes an ADD/EDIT/COMMISSION option **201** to enable a user to edit parameters associated with a selected container and to configure automatic polling features for a selected container.

[0069] When the ADD/EDIT/COMMISSION option **201** is selected by the user, i.e., when the user interface selection device is used to move a pointer over the ADD/EDIT/COMMISSION option **201**, the user is presented with the dialogue box or window **250** shown in **FIG. 8** for displaying parameters associated with a selected container based on a corresponding record in the container table **81 (FIG. 4)**. When the COMPACTORS tab **252** is selected by the user, a COMPACTORS dialogue pane **251** is displayed and presents information in the container table **81** in a record associated with a particular container, identified in a UNIT NAME box **254**. Other tabs and associated panes may be provided to enable the user to view the container database information in different formats, for example, by account, hauler, site or region. The COMPACTORS dialogue pane **251** also permits a user to view and modify records in the container table **81 (FIG. 4)**. The user selects the container information to be viewed by inputting an identifier in the WASTE EDGE ID box **253** in a COMPACTOR section **255** of the COMPACTORS dialogue pane **251**. A scrolling control **257** permits the user to scroll through a list of container identifiers, or a user may search for a particular container identifier by typing the first few characters of the UNIT NAME associated with the container into a search box **258**. When the user inputs or selects a given container identifier in the WASTE EDGE ID box **253**, various information in the container record associated with that selected container identifier is retrieved from the container table and displayed in corresponding boxes in the COMPACTORS dialogue pane **251**.

[0070] In accordance with a primary aspect of the invention, the user may activate or deactivate automatic polling and set the automatic polling interval for a selected container using the AUTOPOLL section **260** of the COMPACTORS dialogue pane **251**. For example, as illustrated in **FIG. 8, a** container identifier "**30**" appears in the WASTER EDGE ID box and the AUTOPOLL section **260** indicates with a check box **262** that automatic polling is activated for the identified container, that is the AUTO-POLL FLAG (TABLE A) field in the container record is set to a "true" value. An automatic polling interval box **264** indicates the automatic polling interval set in the AUTO-POLL INTERVAL field in the container record. The COMPACTORS dialogue pane **251** permits the user to toggle the AUTO-POLL FLAG by interacting with, i.e., pointing and clicking, on the check box **262**. The user may change the AUTO-POLL INTERVAL value by typing an appropriate number in an autopoll interval box **264**. The modified fields in the container record may be stored in the container table **81** when the user selects a SAVE control button **265**. Thus, the COMPACTORS dialogue pane **251**, which may be generated by the polling module **86**, or a separate module, in conjunction with the display module **94**, permits user-modification of the polling parameters associated with each container in the container network.

[0071] As will be recognized from **FIG. 8**, the COMPACTORS dialogue panc **251** provides for display and modification of other fields in the selected container record. For example, the full pressure, required full compactions, empty pressure and required empty compactions parameters may be modified by user-entry of new values into corresponding boxes. Similarly, the primary and secondary phone numbers that arc dialed by the monitoring unit associated with the given container may be modified. The updated values may be uploaded to the monitoring unit of the given container by user-selection of the COMMISSION NOW control button **270**, which causes a communications link to be established with the monitoring unit associated with the given container and the appropriate parameters uploaded.

[0072] Once the automatic polling parameters have been input by the user for a particular container, automatic polling is facilitated in the background by the communications module **82** by iterating through the container table **81** and creating poll sessions according to the status of the value of the respective AUTO POLL FLAG in each container record. These poll sessions are queued into a stack for execution by the communications module **82** in a manner that will be explained below. **FIG. 9** depicts a flow chart showing the steps performed by an exemplary communications module and polling module to create poll sessions according to the invention. The communications module **82** iterates through the container table **81** in a periodic manner, that is, continuously as part of the communications thread running in the background to the main thread in a multi-tasking operating environment. At step **360**, the next container record is retrieved from the container table **81**. At step **362**, the communications module **82** determines whether the AUTO POLL FLAG is set to a true value for the container. If not, the process branches back to step **360** where the next container record is retrieved. If so, the process then determines whether the AUTO POLL INTERVAL for the container has expired at step **364**. This determination is preferably made by subtracting the time indicated in the LAST CONTACT TIME field of the container record from the current time and determining if the result exceeds the value specified in the AUTO POLL INTERVAL. If the interval has not yet expired, the process branches back to step **360** where the next container record is retrieved. If, at step **364**, it is determined that the interval has expired, a poll session is created for the container at step **366** and at step **368** the poll session is added to or queued into the calling session stack, the operation of which will now be explained.

[0073] The communications module **82** preferably manages communications with monitoring units in the container network using a first-in first-out stack in which calling sessions are queued. The term "calling session" as used herein refers to an outbound polling session that is scheduled according to the automatic polling features of the invention, or to an on-demand outbound polling call requested by the user, or to a full or empty inbound call initiated from a monitoring unit **38**. When a poll session is created as describe above in reference to **FIG. 9**, the session is queued into a calling session stack. The communications module **82** then initiates polling calls according to the poll sessions

queued into the stack on a first-in-first-out basis. In this manner, in accordance with the advantages and objectives of the invention, a number of polling sessions may be queued into the stack and performed while the central computer **50** is unattended.

[0074] According to another feature of the invention, the communications module **82** is adapted to initiate polling calls while permitting the receipt of inbound calls from monitoring units in the container network. Thus, polling sessions may be scheduled and performed without jeopardizing the receipt of high priority calls, such as inbound calls to indicate full containers. **FIG. 10** is a flow chart depicting a process for creating calling sessions in accordance with the invention. At step **310**, the next calling session in the session stack is conducted by the communications module **82**. At step **312**, an inter-session delay is executed in order to permit receipt of inbound calls. At step **314**, a determination is made as to whether or not an inbound call is received. If not, the next calling session queued into the session stack is conducted as the process returns to step **310**. If, at step **314**, an inbound call is received, the communications module **82** next determines, according to the communications protocol described above at step **316**, whether or not the inbound call is an empty call. If so, an empty call session is created at step **318** and placed in the calling session stack at step **320**. According to a primary aspect of the invention, and as illustrated in **FIG. 11**, the empty call session is placed at the head node **352** of the session stack **350** so that the empty call session is performed prior to any other calling sessions queued into the stack. In other words, the other calling sessions queued into the stack are preempted by the empty call session. This permits immediate execution of the empty call session so that the empty call inbound from the corresponding monitoring unit may be received and the transactions table and container table updated accordingly. After step **320** is performed, the process branches back to step **310** to conduct the next calling session queued into the session stack.

[0075] If at step **316**, it is determined that the inbound call is not an empty call, the process continues to step **322**, where a determination is made as to whether the inbound call is a full call. If not, the process returns to step **310** to conduct the next calling session in the stack. If so, the process creates a full call session at step **324** and places the full call session at the head node of the calling session stack at step **326**. In this manner, the full call session is executed in a preemptive manner relative to the other calling sessions queued into the calling session stack to permit immediate receipt of the inbound full call and appropriate updating of the container table and transactions table.

[0076] As described briefly above, an exemplary communications session according to the invention involves a sequence of data interchanges or queries between the central computer and one or more of the monitoring units in the container network. Each session preferably involves a sequence of printable text type commands or responses. Each command has an associated retry count and timeout interval. If the retries are exhausted or the timeout interval is exceeded, the session is aborted and a transaction denoting this error condition is created in the transactions table **83**.

[0077] **FIG. 12** illustrates an exemplary dialog for a polling session. Once a communications link is established, commands are transmitted by the central computer **50** using, for example, an ASCII sequence of characters. For example, the central computer **50** may first request the unit number of the container using the command "<U" and the monitoring unit **38** may respond with an ASCII sequence in the form ">U01" to respond with a unit number "01". According to this exemplary portocol, each of the commands illustrated in the left table in **FIG. 11**, except for the hang-up command, seeks a response in the format as shown in the right table. Moreover, a retry count and timeout interval are assigned to each command in order to provide for the detection of error conditions, due for example to interference or noise in the communications link. If the timeout interval is exceeded, the command transmission is retried. If the retry count is exceeded, an error transaction is stored in the transaction table for the container.

[0078] It will be readily apparent from the foregoing detailed description of the invention and from the illustrations thereof that numerous variations and modifications may be effected without departing from the true spirit and scope of the novel concepts or principles of this invention, the scope of which is defined in the appended claims. Although the preferred embodiment has been described with reference to monitoring units, such as those described in U.S. Pat. No. 5,303,642, that make a container fullness determination at the container site, those of ordinary skill in the art will recognize from the foregoing that the primary features of the invention are adaptable to container network systems, such as those disclosed in U.S. Pat. No. 5,016,197, in which fullness determinations are made at the central computer **50**. In such an adaptation, the full container module **90** may make a full determination based on a comparison of pressure data communicated by the monitoring units to a maximum value, and the full container display zone updated based on the fullness determination made by the central computer.

[0079] It will also be recognized that, while the invention has been described with reference to containers that have compactor assemblies associated with them, the invention is also adaptable to open-top type containers which have no compactor assemblies associated with them. The fullness of such containers may be determined by a human attendant, who would initiate a telephone call to report a full condition. According to the invention, a full call switch may be provided at the container site, preferably as part of the status monitor, to initiate a full call when activated by a human operator. The telephone number to be called may be programmed from the central computer and previously uploaded to the status monitor during a commissioning session. Alternatively, the human attendant may be provided with a designated number to call when the container needs to be emptied. A voice-activated or telephone key dialing interface could also be provided to enable the human attendant to input information identifying the container to be emptied. The communications module of the present invention would be adapted to create a FULL transaction in the transaction table for the identified container, and the full container module adapted to update the full container display zone to list the full container.

[0080] It will also be apparent to those of ordinary skill in the art that invention is applicable to networks which are distributed over a wide area. For example, the invention is applicable to Internet-based systems which monitor the

status of a number of containers in a container network. Such a system could make use of communications between the central computer and the monitoring units coupled to one or more of the waste containers.

[0081] In addition to being able to monitor and/or manage the status of the waste containers from a display device coupled to the central computer or associated with the central location, in at least one embodiment of the present invention, the status information could also be accessible via one or more remote monitors, thereby allowing for potentially more convenient access to the information by a greater number of people. This would continue to allow the data to be centrally managed and maintained, but would also allow multiple individuals to more readily have direct access to the information. This would be particularly useful in organizations where multiple individual may have an interest in the data being generated and/or business efficiencies can be enhanced by making the information more widely available.

[0082] For example, the information could be used by individuals in accounts payable to verify bills received from the refuse hauler, not only to verify that a pick up occurred on the date indicated, but that the pick up occurred as a result of a pick up request by the system. Additionally, the information could be used by individuals responsible for maintenance and repair of the compactor units. A dispatcher in repair may be able to remotely diagnose possible problems with a particular waste container by viewing the past use data, thereby insuring that the repair technician has the appropriate replacement parts prior to being dispatched for service.

[0083] In at least one instance the remote monitoring is accessible via one or more computers coupled to a public global wide area communication network, like the Internet. In these instances it would be further beneficial if the status information can be accessed and viewed using standard Internet browser software, thereby allowing users to access the information without first having to install any custom or use specific data access software.

[0084] Potentially any data available locally at the central computer data server from the data base could be similarly made available at one or more of the remote monitors. Management control could also be performed at one or more of the remote monitors. Alternatively the data or control functionality could be made selectively available. Different user log-in accounts could be used to provide selective access to different levels of control or types of information. In this way, any sensitive data could be protected or access could be simplified so as to be only focused upon the data or elements that the particular user is interested in.

[0085] **FIG. 13** illustrates the remote access portion of one exemplary system **400** for remotely managing a waste container network including a central computer/data server **402** and one or more remote monitors **404**. The central computer/data server **402** and the remote monitors **404**, are each communicatively coupled to a communication network **406**. As noted previously, in at least one instance the communication network **406** is a public global wide area communication network, like the Internet. This would enable any browser enabled computer that is coupled to the Internet to potentially provide remote monitoring functionality. Correspondingly, the specific nature of the communication connection can take one or more of several different well known forms. For example, access to the network could be via a dial-up modem and telephone line connection. Alternatively, the network could be accessed via a hard wired or wireless connection, through the use of, for example, a network adapter or radio transceiver. The central computer/data server **402** would continue to have communication links **36** with the one or more monitoring units **38** coupled to the one or more container **12**, as illustrated in **FIG. 2**. Although it is possible that the monitoring units **38** could also be communicatively coupled to the central computer/data server **402** via the communication network **406**.

[0086] **FIG. 14** illustrates a simplified block diagram of one embodiment of the central computer/data server **402** illustrated in **FIG. 13**. The central computer/data server **402**, generally, is consistent with the block diagram of the computer illustrated in **FIG. 3**, and the block diagram illustrating the relationship between the various modules and database in **FIG. 4**. The processor **408** generally corresponds to the microprocessor **52**, illustrated in **FIG. 3**, and the memory/storage element **410** is generally consistent with memory **54** and storage device **58**, also shown in **FIG. 3**. Similarly, the container communication unit **412** is consistent with the communications device **84**, illustrated in **FIG. 4**, and provides communications with the one or more waste container **12** and corresponding monitoring units **38**.

[0087] In the illustrated embodiment a container database **414**, corresponding to the container database **80**, is stored within memory/storage **410**. Additionally stored in the memory/storage **410** are program data and instruction sequences **416**, which could be used to implement the various modules or components, also illustrated in **FIG. 4**.

[0088] The central computer/data server **402** illustrated in **FIG. 14**, additionally includes a monitor access interface unit **418**, which facilitates communications between the central computer/data server **402** and the one or more remote monitors **404**, via the communication network **406**. As noted previously the specific nature of the communication connection can take one or more of several different well known forms. Correspondingly, the monitor access unit could be one or more of several types of network connecting devices ranging from the previously noted dial-up modem to a radio transceiver.

[0089] The central computer/data server **402** also additionally includes an interface translation module **420**, which can be implemented as a sequence of programming instructions and/or corresponding data, stored in a computer readable medium, such as a memory or storage device **410**. The interface translation module **420** converts the data produced or to be received by the various database queries into a form which is compatible with the remote monitors **404**. In at least one instance, the interface translation module **420** converts the container database **414** output into hypertext markup language instructions or other standard Internet programming language, which can be viewed using a web browser software program being executed on the remote monitor **404**. Data can be received back from the remote monitor through the web browser interface, and correspondingly converted into a form by the interface translation module **420**, which can be used with the container database **414**. In this way, any one who has access to the Internet could theoretically have access to and remotely manage the waste container network.

[0090] FIG. 15 illustrates a simplified block diagram of one embodiment of a remote monitor 404, illustrated in FIG. 13. The remote monitor 404 includes a processor 422, which is coupled to a memory/storage unit 424, and a data server interface unit 426. Similar to the monitor access interface unit 418 of the central computer/data server 402, the data server interface unit 426 can take one or more of several different well known forms for coupling to a communication network 406, the specific form being at least in part dependent upon the type of the communication network.

[0091] However, it is possible for the monitor access interface unit 418 to be different than the data server interface unit 426. This is especially the case where the communication network 406 is a public global wide area communication network, like the Internet, where multiple different types and ways of connecting to and communicating over the Internet have been developed. Where the communication network 406 is the Internet, the central computer/data server 402 could be coupled to the communication network in any one or more of the ways that have been developed for connecting to the Internet, and while one or more of the remote monitors 404 might be connected in a similar manner to the Internet, they could also alternatively be connected in a manner consistent with any of the other various alternative ways to connect to the Internet. Similarly, the different remote monitors 404 might also be coupled to the communication network 406 using various different types of alternative technologies, without impairing the ability of the remote monitor units 404 to communicate with the central computer/data server 402.

[0092] While the remote monitors 404 and central computer/data server 402 have been shown as being coupled together via a communication network 406, it is also alternatively possible that the two could be coupled together directly, independent of a corresponding communication network 406.

[0093] The memory/storage unit 424 of the remote monitor 404, includes sequences of programming instructions and/or corresponding program data 428. In at least one embodiment, the memory/storage unit 424 includes programming instruction/data sequences for implementing web browsing software 430.

[0094] The remote monitor 404 further includes a user output device 432 upon which information received from the central computer/data server 402 can be presented to the user, one such example including a display device 434 or video monitor, upon which the received information can be displayed. The remote monitor still further includes a user input device 436 for receiving user input and conveying the received user input to the central computer/data server 402. Examples of user input devices 436 include a keyboard 438, a mouse or other pointing device 440.

[0095] From the foregoing, it will be observed that numerous variations and modifications may be effected without departing from the spirit and scope of the invention. It is to be understood that no limitation with respect to the specific apparatus illustrated herein is intended or should be inferred. It is, of course, intended to cover by the appended claims all such modifications as fall within the scope of the claims.

What is claimed is:

1. A system for remotely managing a waste container network, the container network including one or more waste containers, each container having associated therewith a monitoring unit for communicating status information to a remote location, the system comprising:

a computer data server comprising a container communication unit for communicating with the monitoring unit of each of the one or more waste containers and for receiving status information, a processor for executing a plurality of prestored instructions including instructions for creating and maintaining a container database, based at least in part upon the status information received, and a monitor access interface unit for providing an interface between the computer data server and one or more remote monitors; and

one or more remote monitors each including a data server interface unit communicatively coupled to the monitor access interface unit of the computer data server, a user output device for supplying waste container status information received from the computer data server via the server interface unit to a user, and a user input device for supplying information received from a user to the computer data server via the data server interface unit.

2. The system of claim 1, wherein the monitor access interface unit of the computer data server and the one or more data server interface units of the one or more remote monitors are communicatively coupled together via a communication network.

3. The system of claim 2, wherein the communication network is a public global wide area communication network.

4. The system of claim 2, wherein the computer data server further comprises an interface translation module which converts the waste container status information into a report or form which can be readily received by the output device via the communication network.

5. The system of claim 4, wherein the output device of at least some of the one or more remote monitors includes a display device upon which the waste container status information is adapted for being displayed.

6. The system of claim 4, wherein the report or form includes selectable links or fields which are adapted for receiving user selection or data input via the user input device for receipt by the interface translation module of the computer data server via the communication network.

7. The system of claim 6, wherein the user input device includes at least one of a keyboard, a mouse, and a pointing device.

8. The system of claim 4, wherein the one or more remote monitors includes a processor and browser software instructions being executed on said processor.

9. The system of claim 8, wherein the interface translation module converts the waste container status information into hypertext markup language instructions for display on the user output device by the processor executing browser software instructions.

10. A method of remotely monitoring a waste container network, the container network including a plurality of waste containers, each container having associated therewith a monitoring unit for monitoring status information associated with the container and for communicating the status information to a remote location, the method comprising:

receiving waste container status information at a central computer;

storing the status information in the a database and on the central computer; and

accessing the waste container status information via one or more remote monitors communicatively coupled to the central computer via a communication network.

11. The method of claim **10**, wherein accessing the waste container status information includes converting the status information into a report or form which can be readily received by an output device of the one or more remote monitors.

12. The method of claim **11**, wherein accessing the waste container status information includes populating one or more fields included within the report or form with user data supplied via a user input device.

13. The method of claim **11**, wherein converting the status information includes converting the information into hypertext markup language instructions for being accessed via browser software being executed by a processor on the one or more remote monitors.

14. The method of claim **10**, wherein the communication network is a public global wide area communication network.

15. The method of claim **10** wherein accessing the waste container status information includes supplying information at one or more of the remote monitors on a display device.

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